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OF A
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RED BY R. C. BRYANT
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UNIV. OF CALIFORNIA

AN OUTLINE FOR A FIELD STUDY OF A LUMBER OPERATION

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PREFACE

THIS outline was first published in 1912 for the use of students of the senior class of the Yale School of Forestry and for others who might wish a guide to aid them in the preparation of a report on the field operations of a lumber company. An effort has been made to include the general methods and practices in all forest regions, hence certain topics which appear in the outline will not apply to specific operations, and on the other hand there may be omissions of certain details which apply to local conditions and which the student should cover.

Acknowledgment is hereby made to the various alumni and others who have furnished criticisms and suggestions of the first outline which have been of great aid in preparing this revision.

New Haven, Connecticut,
March 1, 1922.

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AN OUTLINE FOR A FIELD STUDY OF A LUMBER OPERATION

THIS outline is merely a guide to field observations and the student is expected to cover all details of the operation, even though some of them may not appear in the outline. Strict attention should be given to details even though they may appear of minor importance only. The written report should be presented in readable form and the topics discussed in the order in which they appear in the outline. Liberal use should be made of maps, diagrams, sketches, and photographs since they are a great aid in making the text clear.

LOGGING AND LUMBER MANUFACTURE

I. THE REGION

A. Topographic and climatic features of the region and their influence on the methods and time of logging and lumber manufacture.

II. OWNERSHIP AND MANAGEMENT

A. Organization chart showing the division of responsibility among the management and subordinates.

B. Capital invested, or capital stock.

C. Property.

Title: fee simple—timber rights—from whom secured

(state chief features of timber contract and, if possible, secure copy of same).

Stumpage: original cost—present value—how acquired.

Taxation: assessed value and tax rate.

D. Contracts.

Character of those used for any part of the operation, including the sale or purchase of logs (secure copy of all contracts, when possible).

E. Workmen's Compensation Act—chief features of.

F. Timber bonds: amount and value. Important features of "Deed of Trust."

G. Annual and daily cut of company.

H. Average number of days worked per year? Season in which operations are carried on?

I. Association membership.

J. Accounting methods (secure copy of blank report forms, if possible).

K. Costs of production, itemized.

III. THE FOREST

A. Area.

B. Silvicultural condition.

C. Stand per acre, and total for each merchantable species.

D. Reproduction: present condition and possibilities for, both on uncut and on cut-over lands.

E. Condition of cut-over lands at 5- and 10-year intervals after logging.

F. Scheme of fire protection and its efficiency.

G. Attitude of owners toward forest management.

H. Form of management best adapted to the region.

I. Length of time logging has been in progress on the tract and time at which the operation will be completed.

J. Disposal of cut-over lands.

K. Demarcation of forest boundaries.

L. Scheme of public land survey in region.

IV. THE LOGGING OPERATION*

A. The Timber Cruise.
   1. Methods of cruising and mapping used in the region.
   2. Accuracy required and obtained for both cruise and map.
   3. Character of reports (submit blank forms if possible).
   4. Crew, equipment and supplies required, time consumed, and total cost of making a cruise and map of a given area and stand, according to local practice.

B. Preliminary Work.
   1. Planning the logging operation: methods.
   2. Accuracy with which the various parts of the operation are estimated—methods of estimating costs in the field.

C. Labor.
   1. Nationality.
   2. How employed: day, week, month, year, or contract.
   3. Number of men and duties of each.
   4. Wages and hours of labor.
   5. Bonus or like systems.
   6. Labor organizations.
   7. Total daily expense for labor and board.
   8. Average daily output per man.

D. Camps.
   1. Factors governing selection of site.
   2. Kind, size, number, and arrangement of buildings required for a given crew. Make a ground plan, drawn to scale, of the camp site showing all buildings and topographic features.

*Report should be made on all rough products of the forest, such as shingle bolts, fuel-wood, hewed cross ties, poles, posts, stakes, etc., which are removed either at the time of logging or at a later period.

3. Construction.
   a. Material: kind and amount required for each building—source—value.
   b. Labor (manual and animal): amount required to build a given set of camps—cost.
   c. Show interior arrangement of buildings by accurate sketches.
   d. Transportation: log and board camps (non-portable)—portable houses—floating camps—car camps.
   e. Cost of lodging, if any, deducted from wage.
4. Equipment.*
   a. Stoves: kind and size required for cooking and heating.
   b. Kitchen utensils and dining room ware—prepare a complete list, stating total value.
   c. Furniture: character and amount required—make sketches of bunks, benches, tables, and other camp-made furniture.
   d. Bedding: character and amount per man—by whom furnished—rules with reference to—total value for the camp.
   e. Laundry: equipment furnished—camp rules with reference to.
   f. Drying rooms: character of equipment and amount required for a given number of men.
   g. Refrigeration plants: size, character, and cost.
   h. Cost of bedding, laundry, etc., per man.
5. Camp hygiene.
   a. Sanitary arrangements, and rules.
   b. Air and window space: number of cubic feet per man?
   c. Bathing: conveniences for—rules regarding.
   d. Medical attention: provisions for—cost to employee.

*Where camp is composed of families and the company provides houses only, state terms under which the latter are furnished.

e. Camp disinfection: character—frequency—method.

f. Social welfare: provision for.

6. Blacksmith and machine shop.

a. Kind and value of equipment—supplies carried in stock—crew employed—character of work done—cost for supplies and for labor.

7. Tool fitting.

a. Saws and axes: methods and equipment.

8. Camp store.

a. Stock on hand and sale prices.

b. Average monthly expense per family, or per man.

9. Commissary Department.

a. Kind, amount, and value of supplies carried on hand.

b. Rations: kind and amount—bill of fare for a given week.

c. Average cost of board per week. State items included in cost.

10. Transportation of supplies.

a. Toting.

aa. Principles and methods involved in the location, construction, and maintenance of tote roads.

bb. Crew required to build and maintain roads—cost per rod, mile, or other unit.

cc. Equipment used in toting, tonnage hauled per load—cost of toting per ton for given distances and conditions.

b. Method of transporting supplies other than by sled or wagon—cost per ton.

E. Animals.

1. Kind used, source, value.

2. Type of animal preferred, weight, average life.

3. Rations: kind—quantity—cost per animal.

4. Stable equipment for each animal—total stable equipment for a given number of animals.

5. Veterinary care of animals: common ailments—causes—effect on efficiency of animals.
6. Stable: special features of, shown by sketch, drawn to scale.

F. Felling and Log Making.

1. Tools: quantity and purpose for which used—methods of use—value of each kind. (Submit sketch of any special tools used.)
2. Crews: organization and supervision.
3. Felling.
   a. Deadening: object—method—number of trees per day—cost per tree.
   b. Felling strips: object—size—how and by whom are they laid out.
   c. Felling direction: factors influencing—methods of determining.
   d. Stumps: minimum diameter—height—influence of defects on selection of cutting point.
   e. Undercut: object—size with reference to diameter at cutting point—position with reference to felling direction—variation in practice for hardwoods and soft woods and for small and very large timber—for uphill fall as opposed to downhill.
   f. Sawing or chopping: location of cut with reference to undercut—methods.
   g. Special methods for power skidding.
   h. Bed for large trees: object—character.
   i. Splitting large logs: method—powder charge used—character and amount of loss occasioned by.
   j. Breakage in felling: character—amount—reasons for.
   k. Bedding trees: character, size, and disposition of.
   l. Power felling devices: character—efficiency—crew required—output—cost of machine. Compare with hand methods.

m. Peeling (other than for tanbark): species peeled (reason for)—volume of bark—influence of season—methods and tools—daily output per man—cost.

n. Burning refuse: season—methods—tools—crew—cost.

4. Log making or bucking.

a. Log lengths: maximum, minimum, and average length—how and by whom determined—trimming length.

b. Tops: minimum diameter—rules regarding.

c. Hand and power methods: relative efficiency—output per unit—advantages of system used.

d. Supervision: character of.

5. Swamping or limbing: when done (before or after marking)—if done before swamping does it affect utilization and cause waste—tools used—daily output per man—cost.

6. Regulations: lodged trees—injury to young growth or other timber left standing—swamping—top lopping—species to be removed—quality of timber to be removed—manner of enforcing regulations—efficiency of system.

7. Payment: basis—reasons for choice—cost per unit. (Describe in detail any bonus or like system used and its merits.)

8. Utilization: character and amount of waste in felling or log-making due to high stumps, improper log lengths, improper division of defective boles, failure to utilize fully the top, and breakage due to carelessness. (Instructor will furnish a special form for recording the field data.)

G. Skidding and Yarding.

1. With animals.

a. Preparation of logs for skidding (swamping, sniping, barking, etc.).

b. Describe fully, and illustrate with sketches drawn to scale, the equipment used to skid logs

(harness, chokers, grabs, tongs, go-devils, drays, yarding sleds, self-loading skidders, two wheeled carts, etc.). Cost and make of each kind of equipment.

c. Crews: organization—number of men and animals in each—tools and equipment required per crew—number of crews required to put in a given amount of timber per day.

d. Skidding trails and roads: location—method of construction—maintenance. Average cost of trails and roads, per rod.

e. Skidways: rules for location—method of construction—kind and size of timber used—crew required for construction—cost.

f. Describe fully the method of skidding logs. When logging is done by contract, state terms. On what is contract price based?

g. Amount of timber handled in a given time, with a given form of equipment, for 100—200—500 and 750 feet and for 1-4, 1-2, and 3-4 of a mile. Cost per 1000 feet log scale. (State average length and contents of logs, character and topography, condition of bottom, climatic conditions, kind and condition of animals, wages, and team hire. Instructor will provide a special form for recording field data.)

h. Relation of animal skidding to forest management.

2. With power (other than tractors).

a. Special preparation of logs for skidding with power (including deadening, swamping, noseing, or other processes).

b. System of power skidding used (cableway, slack rope, or snaking) and advantages for the specific operation—cost of one unit.

c. Describe fully the power skidding and loading equipment, and the accessories such as water tanks, repair outfit, and blocks—spark arresters

used and their efficiency, regulations with reference to their use—method of changing runs, etc. (Submit sketches showing chief features of machine, methods of changing runs, and location of landing and runs from one set-up.)

d. Factors governing the choice of landings and limits of area to be logged from one set-up.

e. General scheme of railroad or other means of transport for machines and logs. (Submit map showing transportation layout for a limited area.)

f. Cables: number, size, length, type, quality, make, average life in terms of feet log scale, maintenance methods, value, disposition of worn cables.

g. Methods of operation, including laying-out job, moving and setting up equipment, skidding, and loading.

h. Crew: organization, number of men, qualifications, and duties.

i. Animals: number—duties.

j. Fuel: kind, amount, how secured, relative efficiency, cost per unit.

k. Water requirements per day—how provided.

l. Capacity, daily, of machine in logs and log scale, for given distances (to be determined by time studies, showing distribution of time for each part of operation).

m. Relation of power skidding to forest management, based on damage to young growth and disturbance of ground surface.

n. Spare parts carried in stock for each unit.

3. With tractors.

a. Type of tractor used—horse power—speed loaded and empty—hauling capacity.

b. Loading devices: winches or other equipment.

c. Trailers: type—capacity—method of attachment to tractor.

d. Maintenance: character of repairs necessary—

frequency—skill demanded—spare parts carried in stock—cost of.

e. Oil and fuel requirements.

f. Crew: number, duties, and wages.

g. Character of roads, trails, or slides.

h. Method of operation—working radius.

i. Prepare tables showing number of trips made under stated conditions of bottom, topography, and size of timber for given distances (to be determined by time studies).

j. Prepare sketches showing important features of the machine and of the auxiliary equipment.

k. Logging costs as compared to other methods used on same job.

H. Scaling.

1. Log rule used.

2. Log scaler's equipment: scale stick—books—crayons.

3. Method of scaling: scheme for "cutting" defective logs—interpretation of a merchantable log—measurement of sound logs—recording results.

4. Check scaling: how and by whom done.

5. Scaling crew: number of men—manner of employment.

6. Reports (character and to whom submitted).

7. Marking logs: method—tools—log marks in use—law in regard to log marks.

I. Brush Disposal.

1. Object.

2. Laws in regard to.

3. Lopping: methods—efficiency—crew.

4. Scattering brush: methods—efficiency—crew.

5. Piling: season—method.

6. Burning: season—method—tools—efficiency of burning operation.

7. Cost per 1000 feet, log scale.

8. Influence on cost of logging.

J. Land Transportation of Logs.

1. On sleds.

a. Two-sleds, or other types.

aa. Type: describe and illustrate with sketches the equipment—loading methods, hand, power, and animal.

bb. Draught power.

Animals: kind and number per sled—average load hauled under given conditions—number of round trips made in a given time on hauls of specified lengths and under given conditions.

Power: character of machine used—crew: number—duties—wages. Fuel and water requirements—efficiency, loaded, on different grades—method of operation—equipment required for hauling a given amount a specified distance, under stated conditions.

b. Roads.

aa. Location: principles—methods.

bb. Construction: grading—corduroy work—bridge construction—season—crews; number of men, duties, wages, time required to build a given amount of specified road—cost of each part of work—total cost per mile, or other unit.

cc. Maintenance: character of repairs—crews: duties and wages.

Equipment: describe and submit sketch of snow plough, rutt cutter, and sprinkler—cost.

dd. Cost of roads itemized.

c. Landings: character—size—capacity—methods of construction—unloading and banking—crew—itemized cost per 1000 feet, log scale.

2. On wheels.

a. High wheels.

aa. Type and make of cart and equipment—advantages of. (Submit sketches.)

bb. Preparation of logs for hauling—length and size of logs handled—swamping—bunching—loading—unloading.

cc. Operation: methods.

dd. Draught power: animals—kind, number, efficiency.

ee. Output: amount handled daily for given distances and conditions—cost per 1000 feet, log scale (based on time studies).

ff. Relative efficiency as compared to wagons, motor trucks, and other forms of equipment used to move logs.

b. Wagons, 4-, 6-, and 8-wheeled.

aa. Type used: wagon equipment—cost.

bb. Logs: lengths handled—swamping—"bunching"—loading—unloading.

cc. Draught power.

Animals: kind—number—efficiency—cost.

Mechanical: type of draught power used—cost—kind, amount, and value of fuel—advantage.

dd. Crews.

Organization: wages—number of men and animals required for a given job.

ee. Roads: location—construction—maintenance—cost.

ff. Operation: prepare a tabular statement showing time required per trip for given conditions and distance—minimum, average, and maximum loads hauled—crew—wages—conditions of road bed—grades—and physical condition of animals. Average daily output per unit—cost per 1000 feet, log scale (based on time studies).

gg. Relative efficiency as compared to carts, motor trucks, and other equipment used for moving logs.

c. Motor trucks.

aa. Type used—rated capacity in tons—capacity in feet log scale—engine horse-power—advantages of type for logging purposes.

bb. Type of body used; including bunks, load-

ing devices, etc. (show special features by sketches).

cc. Type of trailer used. Describe and illustrate any special features by sketches.

dd. Size and length of logs that can be handled, and average number per load.

ee. Fuel and oil requirements, daily and monthly.

ff. Maintenance requirements—chief troubles—spare parts carried on hand—skill required in repair work—crew for repair work.

gg. Loading and hauling practice.

hh. Number of trips per day for given distances, bottom, topography, and loads (based on time studies).

ii. Roads: character, construction, and maintenance.

jj. Crews: number of men—duties.

kk. Cost per 1000 feet, log scale, for given distances and conditions. Compare with other forms of transport for similar conditions.

ll. Make sketches of, and describe carefully all important features of the motor truck, auxiliary equipment and special forms of roadbeds.

3. Slides and chutes.
   a. Conditions under which used.
   b. Location: principles and methods—curves, grades, etc.
   c. Form of slide and terminals: describe and show by sketches, drawn to scale.
   d. Construction: methods—material—crews.
   e. Operation: feeding and tending the slide—length and diameter of logs handled—log control—crews—cost per 1000 feet handled.
   f. Maintenance: life of slide—character of repairs—crew required—cost.

4. Aerial tramways.
   a. Conditions under which used.
   b. Construction: methods—materials required—

cost for labor and materials—make sketches drawn to scale of towers, cable supports, trolleys, loading and unloading platforms, and other essential features.

c. Power: character of device used for operation of trolley.

d. Operation: method—crews—capacity—cost.

e. Maintenance: average life—character of and amount of repairs required—supplies carried on hand—cost.

5. Road engine (Bull Donkey).

a. Adaptability.

b. Equipment: types and dimensions of boiler and rated horse power—engines: size of cylinders and length of stroke—cables; size, length, quality, life, cost—number and size of road spools, sheaves, fair-leaders, and like equipment—type of spark arrester used. Cost of equipment per unit.

c. Road: character, location, construction, maintenance, cost.

d. Landings: location, construction, and equipment.

e. Operation: method—crews—cost.

6. Railroad.

a. General: relation of logging road to lumber company—if chartered, reasons for same.

b. Location: factors governing—survey; crews, methods, equipment, cost—curves and grades permissible.

c. Rights-of-way: how secured—width—cost per acre or other unit.

aa. Construction.

(1) Clearing right-of-way:

Methods of felling timber and cutting brush, log lengths of merchantable timber—brush disposal, stumps, height on grade and off grade, methods of stump removal by grub-

bing, blasting or burning, relative ease of removing stumps of different species, amount and kind of explosive used for stumps of given size and species—length of time right-of-way is cut in advance of grading—size and organization of crew and amount of work done, daily, per man—cost of clearing per acre or other unit.

(2) Grading:

Material: classification of, and determination of amount of yardage.

Rock: Methods of blasting or other means of reducing to a size that can be handled, including drilling, loading holes, kind and amount of explosive, fuse and caps; labor required; cost per cubic yard for supplies.

Earth: methods and equipment used in moving; labor required; cost per cubic yard.

Labor: organization of crews, daily output per man, cost per cubic yard.

Grade cross section: profile on level and on fills and in cuts, shown by sketches drawn to scale.

(3) Timber work:

Trestles: type—character and size of timber used for the various members—character and amount of hardware required—equipment used for construction purposes—methods of construction—amount of timber required in construction—when are trestles used in preference to a fill or a truss bridge.

Culverts: same data as for trestles.

Cribbing: same data as for trestles.

Corduroy: same data as for trestles.

Bridges: same data as for trestles.

Labor: organization of crews, number of men required and qualifications, daily output per man for structures of different heights.

Cost for labor and materials itemized, for different classes of structures, per linear foot.

(4) Supplies.

Rails: weight, condition, and cost.

Rail accessories: character of rail fastenings, bolts, spikes, rail braces, crossings, switch frogs, and throws.

Ties (standard and switch): species, size, source, life, number per rail, cost.

(5) Steel laying and removal: equipment, including description and sketch of rail and tie car or track-laying machine—crew; organization, size, and duties—methods—number of rails laid or taken up, daily, per man; cost.

(6) Surfacing: character of work, crew required and its organization; methods, cost.

bb. Maintenance of way: character of work—methods—number and size of section crews—wages—cost.

d. Equipment.

aa. Locomotives: number, type, make, tonnage loaded, hauling ability on given grades—general efficiency—fuel, water, and oil requirements—spare arresters; type, efficiency, state laws with reference to.

bb. Cars: number, character, capacity, make, weight, bunk spikes or chock blocks—chain holding devices—length of logs handled (maximum, minimum, and average)—character of usual repairs and maintenance necessary. Show special features of cars by sketches, drawn to scale.

cc. Repair shop: equipment, methods, crew.

dd. Loading equipment:

(1) Type of loading device used: cross-haul, gin pole, sky line, other power loaders.

(Describe and illustrate by sketches any special features connected with the loading equipment.)

(2) Capacity: length and size of logs handled (maximum, minimum, and average lengths and diameters)—time required to load cars—fuel, oil, and water requirements of power loaders—maximum working radius—size and duties of crew—methods used in loading.

(3) Repairs: character, method, equipment required, crews, cost.

K. Water Transport.

1. Streams, lakes, and the ocean.

a. Requirements of driveable stream or other body of water.

b. Improvements.

aa. Dams: requirements for a good site; methods, crews, amount of material required and cost of construction; form of gates used. Show structure of dam and gates by sketches, drawn to scale.

bb. Booms, wing dams, etc.: form; construction; use; and cost. Illustrate different forms by sketches, drawn to scale.

cc. Sluices and log flumes: conditions under which used; form; location; construction; operation; maintenance; cost.

dd. Stream cleaning; removal of débris, drift wood, rock, etc.; methods; equipment; cost.

ee. Sorting gaps: form; purpose for which used; show arrangement and construction of gaps, booms, piers, etc., by sketches drawn to scale.

c. The drive.

aa. Season and distance.

bb. Landing: "breaking down," movement of logs through splash dam.

cc. Management of drive on small and large

streams (private, union, boom company, or combination of two or more); character and amount of equipment required.

dd. Crews: number of men, wages, camp management.

ee. Sorting: objects—methods—crews—contents in feet—log scale of average log—daily and annual capacity of sorting works—cost per 1000 feet, log scale.

ff. Deadheads: equipment for and methods of recovery; percentage of loss in scale between "bank" and mill, and reasons for same; ownership and value of logs; transportation to mill.

gg. Log damage: character and amount due to toredos, "brooming," breakage, sap rot, or other causes.

d. Rafting.

aa. Reasons for and laws with reference to.

bb. Raft construction: methods; form and size; equipment and crew required to construct; cost.

e. Towing: character of tug boats and other equipment used; pulling ability; amount of fuel used; crew; cost of operation per 1000 feet.

f. Flumes: see schedule, page 32.

g. Prepare a tabulated statement showing total crew employed, duties, wages, and division of responsibility and daily output per man.

L. Prepare a Glossary of Terms used in Logging.

V. LUMBER MANUFACTURE

A. The Plant.

1. Location and advantages of the site.
2. Character of plant, including mills, dwellings, commissaries, office buildings, etc.
3. Form of local government, incorporated or non-incorporated—reasons for, and advantages of plan.
4. Merits of the plant.
5. Daily and annual output.

6. Organization: prepare a chart showing the scheme of organization of labor, duties, wages, and division of responsibility.
7. Prepare a ground plan of entire plant (scale 1 inch = 200 feet), showing location of all buildings, lumber yard, refuse burners, water tanks, hose houses, fire plugs, log pond, etc.

B. Sawmill.
1. Log storage.
a. Water.
aa. Rollways: form of rollway at log pond or on stream including height of brow above water. Show construction by sketches drawn to scale.
bb. Log unloading devices: describe the equipment used for unloading log cars—efficiency of method—log breakage in unloading—danger to workmen—does train crew or special crew do the unloading—show important features by sketch drawn to scale.
cc. Pond or stream: area, capacity in 1000 feet, log scale, arrangement of booms, method of handling logs, control of flood water.
dd. Character and amount of damage from toredo or other causes due to long storage in water.
ee. Power log bucking devices: equipment used, location with reference to mill, method of operation, crew required. Make sketch of equipment.
ff. Deadheads: class of logs that sink; equipment for, and methods of raising; cost.
gg. Hot ponds: method of keeping pond open in cold weather.
b. Land.
aa. Rollways: form of rollway or storage ground, area, capacity.
bb. Log handling devices: character, method of operation, crew required, capacity.

cc. Sketch drawn to scale of log storage area and log handling devices.

c. Labor: crews, organization, duties, wages.

d. Storage expense: statement showing expense per 1000 feet.

2. Equipment and operation of mill.

a. Make a ground plan, to scale, showing arrangement of machinery on sawing floor.

b. Building: dimensions; type of construction; necessity for and character of natural and artificial light; amount of material required for construction; size of important members; cost per unit for labor and materials.

c. Log hoisting machinery: describe and illustrate the equipment used for and the methods of bringing logs from the pond or storage yard to the log deck.

d. Log washing devices: objects, character, amount of water required, source.

e. Deck machinery: describe and illustrate the deck machines and equipment, and the mode of operation (cut off saws, drag saws, log-stops and loaders, "niggers," log turners, etc.), amount of manual labor involved in operation.

f. Log carriage: describe carriages (length, maximum diameter of log handled, log "dogs," set works, knees, blocks, offset, trailer, etc.).

g. Carriage feed.

aa. Steam: length and diameter of cylinder, diameter of piston, attachment to carriage, valves, method of speed control, length of run, steam requirements.

bb. Cable: size, power, and location of engine; length, size, and character of cable; length of run; speed; attachment to carriage; control.

cc. Rack and pinion: dimensions of rack and of pinion; speed; method of control.

h. Carriage tracks: length of run; gauge, size, and form of track; number of rails and method of attachment to floor; type of track cleaners.

.. Bumpers: object, form, location.

j. Band mills: chief features; make; diameter of wheels, crown, saw stretching device, r.p.m.,* h.p.† required, length of saw (maximum and minimum), largest log passing under the saw guide; log splitters, character, and when used.‡

k. Circular mill: chief features of husk; make; r.p.m. of saw; board spreader; feed works; h.p. required; character of logs sawed; top saw, direction of rotation, r.p.m.

l. Rock saw: object of; character; power application; method of use.

m. Sash gang mill: chief features; make; size; number of saws; strokes per minute; foundation; h.p. required; character of logs sawed; advantages of gang saw.

n. Resaws: chief features, advantages (follow band mill, or circular mill, schedule according to character of resaw).

o. Saws.

aa. Band: length, width, gauge of teeth and of blade, number of teeth per linear foot, shape of teeth, tension, tire, kerf, feed speed, number of 1000 feet B.M.§ sawed at one filing, average life, daily cut per saw, number of saws on hand, use made of worn saws, cost of saws per linear foot.

bb. Circular: diameter; gauge; tension; speed; shape, size, and number of teeth; kerf; feed; number of 1000 feet B.M. sawed at one filing; life of saw; daily cut; number of saws on hand; cost.

*Revolutions per minute.

†Horse power.

‡Describe band log splitter under same headings as for band mill.

§Board measure.

cc. Gang saw: length; width; gauge of teeth and saw blades; tension; size and shape of teeth; kerf; feed; number of 1000 feet B.M. sawed at one filing; life of saw; number of saws on hand; cost.

dd. Resaw: follow schedule for band or circular, as required.

p. Filing: arrangement and equipment of filing room; character of work performed; principles of "saw-fitting"; methods; crew organization, qualifications, and wages; cost per 1000 feet B.M.

q. Edgers: type; number; diameter, and gauge of saw blade and of teeth, arrangement and control of saws; r.p.m.; kerf; feed speed; daily output; h.p. required; crew organization; maximum size of material handled.

r. Trimmer: type; number, diameter, gauge of saws; gauge of teeth; arrangement and control of saws; kerf; r.p.m.; h.p. required; daily output; maximum length and thickness of boards handled.

s. Slasher: type; arrangement; number, diameter, and gauge of saws; kerf; r.p.m.; h.p. required; disposal of refuse; loss of lath stock due to careless feeding of slabs and edgings to saws.

t. Hog, or refuse grinder: type; arrangement and number of knives; r.p.m.; h.p. required; capacity in cords per hour; class of material ground in the hog.

u. Lumber and cant trips: describe and illustrate the various kinds of trips used in handling lumber, cants, and other material.

v. Board drops or "ease downs"; character and effectiveness in preventing splits behind head saws.

w. Transfer chains and accessories: describe and illustrate the various types of chains used for

conveying lumber, shingles, laths, sawdust, slabs and other refuse.

x. Live rollers: character; arrangement; form of drive; speed; control; h.p. required.

y. Assorting table: length; height; width; kind of chains used; patent assorting and labor saving devices; method of handling lumber; crew.

z. Loading docks: type used for storage and loading of timbers. (Submit sketch, drawn to scale.)

C. Power Plant.

1. Building: character of construction; dimensions; location with reference to yards, sawmills, and other buildings.
2. Boilers: character; number; arrangement; make; size; steam pressure; horse power; boiler accessories, steam drum, water heaters, injectors; character of grates, Dutch ovens, and other special facilities for burning a given kind of fuel; size of fire box; diameter and height of stack.
3. Fuel: kind and amount used; method of fuel transfer to "dust" house and power house; stoking devices.
4. Engines: number; type; make; r.p.m.; h.p. developed; frequency of tests to determine efficiency.
5. Pumps: number; type; make; size of steam, air, and water cylinders; capacity of free air or water; purpose for which used.
6. Power transmission: shafting; size, and location of main and secondary shafts for driving sawmill machinery—belting or rope drive; dimensions and arrangement of all belts and ropes used for transmission.
7. Mill repair: millwright equipment for mill repair; character of repairs made; supplies carried on hand; crew. Frequency of inspection of carriages, mills, and other machinery.

D. Sawing: plain and quarter sawing; manner in which logs of different sizes and possessing various defects (rot, crooks, knots, etc.) are sawed; dimensions of rough green, 4/4, 6/4, 8/4 and other standard sizes, when they leave the saw. Thickness of flitches or planks to be sawed on the resaw. Show diagrammatically the manner in which logs of various sizes are sawed. Method of sawing rough, smooth, and defective logs, also those with sweep. Influence of visible defects on the sawing contents of logs both as to volume and grade as compared to sound, straight logs of the same length and diameter. Character of material reworked on the gang or resaw. Are logs sawed parallel to surface or to axis? Policy with reference to sawing butt-end or small end first. Policy with reference to slabbing. Are slabs resawed? Determine by time studies the per cent of total elapsed time that the sawyer spends on operating log-stop-and-loader, steam nigger, gigging back the carriage, and running the saw in the cut. (Instructor will supply a special outline and detailed instructions.)

E. Logs: number sawed daily; grades produced; per cent of each lumber grade in average daily run of mill; log rule used on the deck; per cent of "overrun"; class of logs that yield the higher and highest grades of lumber.

F. Lumber: kinds of lumber products manufactured; method of manufacture (in detail) from pond to car; grading rules used; grading methods and crew; grades which are air-dried and kiln-dried; shrinkage in seasoning; loss in weight during seasoning; shipping weights of lumber. Per cent of different thicknesses cut. Tallying output of mill.

G. Conditioning Lumber:

1. Objects.
2. Methods.
   a. "Dipping": objects; stain, cause of, kind of wood and species attacked, season of attack;

construction of dipping tank (draw to scale); formula for dipping solution; preparation of solution; length of time lumber is immersed; amount of chemical solution required to dip 1000 board feet; subsequent treatment of lumber; origin and cost of chemicals; crew; cost per 1000 board feet.

b. Yards: area; distance from mill and other buildings; arrangement and construction of "dolly ways"; width and condition of alley ways; equipment for, and method of transporting lumber from the assorting table to yard and yard to planer, or car; character of lumber dried in yard; advantages and disadvantages of yard drying; piles, arrangement, dimensions, foundations, roof, location with reference to prevailing winds, average contents; crews and work performed daily; weight of lumber before and after drying; total crew on yard work; cost of yard work per 1000 board feet.

c. Dry kilns: type; capacity; average temperature and humidity maintained at each end in progressive kiln; kind, size, and amount of heating pipe and its location in kiln; source of heat and steam pressure; disposal of water of condensation; time required to dry lumber of different species and thickness; special problems involved in kiln drying; kiln trucks, character and capacity, method of piling lumber on, automatic stackers; other kiln equipment; handling lumber at receiving and discharging end; per cent of total cut and the grades kiln dried; weight of lumber before and after drying; crew, wages, and duties; labor saving devices used in handling kiln truck loads; cost per 1000 board feet.

d. Dry sheds: construction and capacity (show important features of construction in a sketch

drawn to scale); class of lumber stored and length of time.

3. Plant sanitation: measures in use to keep sheds, yards, and various parts of the plant in a sanitary condition with reference to wood decay.

H. Planing Mill.

1. Building: dimensions; type of construction; location with reference to remainder of plant; character of construction.
2. Equipment: type of machines used; speed and capacity of each machine and of entire plant; h.p. required for each machine and for plant; application of power; make ground plan of building showing location of different machines.
3. Power transmission (see power transmission, saw mill).
4. Output: patterns of finished lumber produced; degree of dryness of lumber for best results; thickness lumber must be in rough to make different patterns; quality and size of lumber from which various patterns are made; waste in manufacture.
5. Assorting lumber: arrangements for and methods of; grading; assorting and handling lumber.
6. Power Plant (see sawmill—power plant).
7. Fuel (see sawmill—fuel).
8. Labor: prepare a chart showing planing mill labor, organization, duties, cost.

I. Study and describe in detail any special forms of utilization practiced in any part of the plant, whereby "shorts," odd lengths, edging strips, trimmings, defective lumber, or refuse are made into a commercial product. (Instructor will provide a special outline.)

J. Refuse Disposal: method for sawmill and planing mill; character and location of enclosed burners and open pits; conveyors; exhaust system; size and character of fan, r.p.m., h.p. required; length and diameter of blow-pipe, volume, velocity, pressure of

air. "Cyclone," size and construction; compressed air cleaning systems.

K. Electric Plant: type, make, and capacity of dynamos; number, candlepower, and location of lights around the plant; capacity of motors and purpose for which used; attitude towards electric machine drive; cost of plant.

L. Water Supply: location and capacity of storage tanks; number, make, type, size, and capacity of pumps; average tank pressure; fire pressure; source of water supply.

M. Fire Protection: equipment for fire protection; fire companies, fire drill; system of automatic sprinklers.

N. Insurance: amount, character, and cost on each part of plant. Insurance requirements.

O. Lubricating Oil: kinds and quantities used for different purposes around the plant, amount carried on hand.

P. Machine Shop: equipment; class of work performed—crew; organization, duties, and wages.

Q. Supply Department: character and amount of supplies carried on hand; how are supplies issued.

R. Submit an itemized statement showing the cost of the following buildings and equipment: the sawmill, power house, planing mill, dry kilns, dry sheds, and other structures.

S. Determine the number of one-man hours required, for each manufacturing process, to produce 1000 board feet of lumber; hours of labor; manner of payment (special outline to be provided by instructor).

T. Submit a chart showing sawmill crew organization, duties and wages. Daily output per man.

U. Glossary of terms used in lumber manufacture, which are peculiar to the region.

VI. LUMBER SHIPMENT AND TRANSPORTATION

A. Shipping Department: organization; duties and qualifications of shipping clerk; blank forms used; crews, wages, duties, and daily output per man; total cost of department per 1000 board feet.

B. Rail Transport: loading: facilities for; methods for flat and box cars; labor saving devices used in loading; capacity in 1000 board feet of cars of various sizes; minimum car capacity; size, quality, and quantity of lumber required to stake flat cars, cost of material and labor per car; weighing cars; demurrage rules; "billing out" cars; crews and daily output; cost per 1000 board feet for loading.

C. Water Transport:

1. Vessels: character of vessels and capacity; method of loading and storing lumber on board for coastwise and ocean cargoes; time and crew required for loading; cost of loading; form of ship charter; general shipping regulations for foreign and domestic trade.
2. Rafts: object; method of raft construction; capacity, length of time and crew required to build; cost of construction; method of transporting to market; cost of transportation; success or failure of past rafting.
3. Flumes:
   a. Location: principles and methods.
   b. Construction: clearing right of way; organization of work; source and kind of material used; form of box used; trestle work; terminals; grades; curves; material and labor requirements; costs.
   c. Operation: crew required; daily capacity; cost.
   d. Maintenance: average life of flume; repairs required; cost.

VII. SALE OF LUMBER

A. Sales Department: organization; force required; methods of sale; cost per 1000 board feet.

B. Markets: territory in which lumber is sold; rail and water freight rates to important markets; chief demands of foreign and domestic markets.

C. Prices: value of lumber f.o.b. car, and at important wholesale markets.

VIII. LATH MANUFACTURE

A. Plastering Lath.

1. Character of raw product used; yield per cord; yield per 1000 board feet of lumber manufactured.
2. Manufacturing plant.
   a. Equipment: character, number, and location of various machines in the plant; relation to sawmill plant (follow schedule for circular saws, when describing saws used in bolter, lath mill, and lath trimmer); character and location of transfer devices for bringing raw product to mill, and removing finished product, and refuse—daily capacity.
3. Manufacture: describe in detail methods of manufacture; sizes of finished product; method of packing; grades; cost for labor, repairs, supplies, etc.
4. Seasoning lath: facilities for; methods; length of time required; shed storage; weight before and after drying.
5. Shipment: methods; car capacities.
6. Crews: crews required to operate, wages, qualifications.
7. Markets and value of product.
8. Trade prejudices against the use of certain species for lath; reasons.

B. Byrkit, or patent lath.

1. Character of material from which made.
2. Advantages of this form of lath.

3. Equipment for, and method of manufacture.
4. Grades.
5. Cost of manufacture and handling.
6. Markets and value of product.

C. Glossary of Terms used in Lath Manufacture.

IX. SHINGLE MANUFACTURE

A. Raw material from which manufactured; yield per cord of bolts, and per 1000 feet, log scale.

B. Manufacture.

1. Plant: location with reference to saw mill; character of power plant; shingle machines, character, number, daily output, crews (follow schedule for circular saws, sawmill, in describing shingle saws)—cost of manufacture.
2. Classification, size, and weight.
3. Packing: methods; daily output per man; cost.
4. Seasoning: methods; time required.
5. Shipment: loading devices; car capacity.
6. Markets: localities in which sold; rates to market; value f.o.b.; chief competing species in important markets.
7. Quality of "mill shingles" as compared to those made from bolts.
8. Glossary of Terms used in Shingle Manufacture.

X. NAVAL STORES INDUSTRY

A. General Data.

1. Organization of woods force; duties.
2. Lease: form and value; operating regulations.
3. Number of crops worked.
4. Number of men employed and character of labor.
5. Size and arrangement of various camp buildings.
6. Total annual output of crude resin and refined turpentine and rosin.

B. Operation.

1. Litter burning; time and method.
2. Class of trees bled.

3. Length of time bled.
4. Yield.
5. Boxing: season; method; dimensions and capacity of box, height of box above ground; average number of boxes per tree; tools used; number of boxes cut daily per man; cost per box.
6. Patent cups.
   a. Preparation of face for cup; season; cost; method and cost of inserting gutters, aprons, or other equipment; method and cost of hanging cup; value of cups; capacity; total cost of placing a crop of cups; yield of crude turpentine in cups; expense of operation; merits of different cup systems; superiority over box system.
7. Cornering: season; method; tools used; number cut daily per man; cost.
8. Chipping and pulling: season; method; tools used; cost; number of boxes worked per man; size and length of "streaks"; how often made; designations of various aged boxes; length of various aged faces.
9. Dipping: frequency; yield; method; cost; method and cost of transportation of "dip" to still.
10. Scraping: season; method of collection; tools; yield of different aged faces.
11. Raking: season; method; cost; efficiency.
12. Effect of box system and cup system on the forest; per cent of trees killed; damage to lumber product.

C. Distillation.
1. Still: equipment, arrangement, capacity, cost.
2. Operation: season; charging the still; time required for distillation; skimming; condensation and storage of spirits of turpentine; determination of progress of distillation; rosin straining apparatus and straining methods; yield of products in quantity and grade.

D. Preparation for Market.
1. Turpentine: character, size, and preparation of

package; cost of package; gauging and determining quality of product.

2. Rosin: character and size of package; equipment of cooperage shop; method and cost of manufacturing barrels; grades.

E. Markets: chiefs centers for sale of product; freight rates to market; character of middlemen in chief markets; value of product.

F. Glossary of Terms used in Naval Stores Industry.

XI. HARVESTING TANBARK

A. Species used.

B. Yield per average tree of a given diameter and per 1000 feet, log scale.

C. Peeling: season; tools required (saws, axes, "spuds," etc.); crew, duties, wages, daily output; felling; ringing; relation to time of logging.

D. Seasoning: method of piling at time of peeling; time required for drying; stacking in the forest; weight per cord green and dry.

E. Transportation: season; equipment (sleds, chutes, carts, wagons, pack animals, manual labor); methods; cost.

F. Markets and sale value of product; freight rates to market; storage at the tannery.

G. Cost of tanbark harvesting.

H. Disposition of peeled wood.

I. Glossary of Terms used in Tanbark Harvesting.

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